

(12) **UK Patent Application** (19) **GB** (11) **2 131 740 A**

(21) Application No **8332150**

(22) Date of filing **1 Dec 1983**

(30) Priority data

(31) **828905**

(32) **3 Dec 1982**

(33) **South Africa (ZA)**

(43) Application published

27 Jun 1984

(51) **INT CL³**

B32B 33/00

(52) Domestic classification

B5N 0712 2704 2708

2728 2730 2732 2740

3300

U1S 1308 1814 B5N

(56) Documents cited

GB A 2098541

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(58) Field of search

B5N

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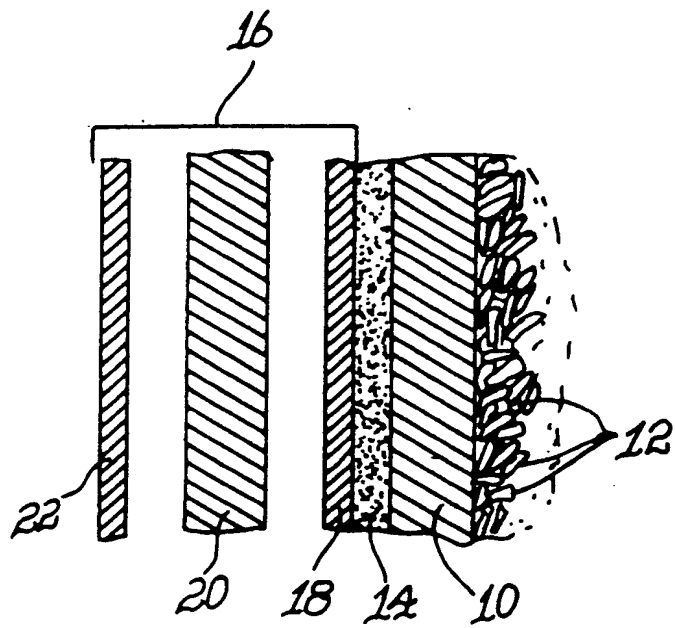
(54) **Packaging material**

(57) This invention concerns a covering material suitable, for example, for use in packaging and wrapping edible substances which are subject to insect infestation. The covering material comprises at least two laminated layers of sheet material having a continuous coating of pesticide between the layers. A permeable ethylene vinyl acetate polymer film

forms a layer towards the substance subject to insect infestation and a permeable polyethylene layer is located on the opposite side of the pesticide coating which is incorporated in a bonding agent uniting the layers. An insect boring through the covering material will contact the pesticide and insect infestation is thereby prevented. The covering material may be used to produce bags and other receptacles.

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SPECIFICATION

Packaging material

This invention relates to covering material and particularly to covering material suitable for packaging and wrapping edible substances.

The invention is particularly concerned with polymer films employed for the manufacture of bags but is not limited thereto. It could, for example, be applied to paper or even cardboard produced in two or more layers and from which bags and other receptacles may be made or which may be used for wrappings.

Polymer films are frequently utilised for the manufacture of bags in which edible substances, such as grain, dried foods, rice or cereals, are stored. Large numbers of filled bags may be stacked in warehouses and it is a well known fact that the contents of the bags are highly susceptible to infestation by pests. Such pests may enter the bags by boring through the walls thereof and it is extremely difficult to treat the bags once they are stacked.

It has been proposed to coat bags with a pesticide or pest repellent (hereinafter referred to simply as pesticide) but the coating tends to wear off and may also be obnoxious to those who handle the bags. It has also been proposed to incorporate the pesticide into the polymer compositions as a constituent thereof but a difficulty associated with this proposal is that the pesticide tends to accumulate in pockets. Over the surface of the film, there are thus zones of relatively high pesticide concentration and zones having substantially no pesticide. Infestation of bags and cross-infestation between bags can still occur if an insect bores through a zone of the film which has substantially no pesticide.

According to the invention, a covering material suitable, for example, for packaging or wrapping edible substances, comprises at least two laminated layers of sheet material and a continuous coating of pesticide between the layers of sheet material.

For the purposes of this specification the term "pesticide" includes a pest repellent.

The pesticide may comprise any suitable insecticide or any other pesticidal compound or a composition containing one or more pesticidally active compounds. Many such compounds and compositions exist. For covering material to be used with edible substances an insecticide of the class trivially referred to as pyrethrins, whether synthetic or derived from a natural source, may be used. Pyrethrins may be used either alone or in combination with a suitable synergist, such as piperonyl butoxide or sesamex, adapted to delay the metabolic detoxification of the insecticide. Natural pyrethrum used on its own or in combination with a suitable synergist, such as piperonyl butoxide, is to be preferred as it is to be regarded as substantially free from toxic side effects upon mammals and insects are not inclined to develop a resistance to it.

In this specification the term "natural pyrethrum" is used to signify an insecticide obtained from flowers of plants of the genus *pyrethrum*, e.g. *Pyrethrum cineræfolium*, and having insecticidal compounds trivially known as pyrethrins and cinerins as its chief insecticidally active constituents.

Any other suitable pesticide may be used depending on the intended application of the covering material. Synthetic pyrethrins may be used instead of a natural pyrethrum derived from a natural source.

Preferably, the pesticide is used in a concentration in which it is substantially non-toxic to humans and other larger mammals.

The two layers of sheet material may be bonded together in any suitable manner, such as by means of a bonding agent.

Any suitable bonding agent compatible with the pesticide may be used. When a pyrethrin insecticide is used a non-alkaline bonding agent should be used.

The bonding agent may comprise a synthetic resin and a hardener therefor.

Preferably, the bonding agent comprises a polyurethane resin, such as that manufactured by Henkel G.m.b.H. and marketed under the trademark "Liofol UK 2600", and a hardener comprising a cross-linking component such as the product also manufactured by Henkel G.m.b.H. and marketed under the trademark "Liofol UK 5000".

In a preferred embodiment of covering material according to the invention the pesticide is incorporated into the bonding agent utilized to unite the layers of sheet material.

The pesticide and the components comprising the bonding agent may be dispersed in a solvent for application to the layers of sheet material. In a coating constituted by the preferred pesticide and bonding composition set out above, the solvent preferably comprises ethylacetate.

Instead of the pesticide being incorporated into a bonding agent uniting the layers of sheet material, the pesticide may be applied to one or both layers of sheet material in any other suitable manner, such as by spraying or printing the pesticide coating by any suitable method together with or separately from the bonding agent.

In a preferred embodiment of the invention at least one and desirably both of the layers of sheet material between which the pesticide is provided comprise polymer material. Any suitable polymer material may be utilised such as ethylenevinyl acetate and/or a polyolefinic polymer, such as polypropylene or polyethylene.

It is to be understood that the invention is not limited to polymer packaging and wrapping materials because paper or cardboard layers or composite layers of say paper and a polymer material may be united by means of a suitable bonding medium, a suitable pesticide being provided between the layers. The layers of sheet material may comprise any other suitable material.

The covering material of the invention may be used in sheet form for wrappings or for the manufacture of bags, boxes, containers or any other desired receptacles depending upon the gauge and flexibility of the covering material.

Receptacles, such as bags for cereal products, made from sheets of the covering material of the invention provide far greater resistance to entry by pests than do receptacles made from untreated materials.

Covering material according to the invention may also be used in sheet form to line or cover the inner surfaces of storage bins, silos and other receptacles.

Covering material according to the invention may be used in any other suitable manner to provide a suitable wrapping or covering as a protection against pest infestation or penetration. Thus a sheet of covering material may be located under and/or over and/or round material or articles to be stacked or stored.

A sheet of the covering material may constitute a chemical barrier which is resistant to penetration by pests. Pests boring through the covering material will contact and be subjected to the toxic effect of the pesticide.

If desired, at least one of the two laminated layers of sheet material between which the pesticide is located may be permeable to the pesticide so that the latter may migrate to at least one side of the covering material or to further layers from which the covering material is made.

Both layers of sheet material may be permeable to the pesticide so that the pesticide may migrate to opposite sides of the covering material.

Applicant believes that migration of the pesticide interiorly of, for example, a bag formed from the material according to the invention may be advantageous in that pests in the bag may be killed and/or that eggs laid in the bag may be prevented from hatching and/or that hatched creatures may be killed.

The layer of sheet material adapted to be located inwardly of the pesticide towards material to be packaged or wrapped in the covering material may comprise ethylene vinyl acetate copolymer and may be relatively more permeable than the layer or layers of sheet material adapted to be located outwardly on the opposite side of the pesticide.

The outward layer of sheet material may be formed as a co-extruded combination film comprising inner and outer laminae of relatively low density polyethylene material sandwiching an intermediate lamina of relatively high density polyethylene. The outer lamina may include an ultra violet ray inhibitor or absorbent for the reason set out below.

In the case of pyrethrums, degradation of the pesticide material is likely to occur through the action of ultra violet rays penetrating the outer layer or layers of packaging materials where these comprise polymer films. In such cases therefore, it

is advisable to incorporate any suitable commercially available ultra violet ray absorbent into the polymer film at least for the outer layer or layers of the laminated covering material.

The invention will now be described, by way of illustration only with reference to a presently preferred embodiment set out in the example below and to the accompanying drawing which is a fragmentary and exploded, cross-sectional view of a sheet of covering material according to the invention.

Referring to the drawing, a sheet of covering material according to the invention suitable for forming, for instance, a bag includes an inner layer 10 of polymer film made from an ethylene vinyl acetate copolymer having a vinyl acetate content of 3%, the inner layer being adapted to be disposed towards an edible substance 12 to be stored in the bag. The inner layer has a density of 0,930 and a melt index of 1,5 GR/m/m as measured on the ASTM D Standard (1238). The average thickness of the inner layer is 25 microns and it has an average oxygen permeability rate of 10 000 cm³ as measured on the ASTM D 1434-63 Standard (DIN 53380).

A continuous coating 14 comprising a bonding agent incorporating a pesticide is provided between the inner layer 10 and an outer layer of sheet material indicated generally by the numeral 16, in order to unite the inner and outer layers 10 and 16. The composition of the bonding agent and of the pesticide of coating 14 will be described in greater detail with reference to the example and tables below.

The outer layer 16 is a co-extruded combination polymer film and consists of an inner lamina 18 of low density polyethylene having a thickness of approximately 7,5 microns, an intermediate lamina 20 of high density polyethylene having a thickness of approximately 25 microns and an outer lamina 22 of low density polyethylene having a thickness of approximately 7,5 microns, the outer lamina 22 including 0,3% of any suitable and commercially available ultra-violet ray inhibitor, which may be in the form of an absorbent, in its composition. The average thickness of the outer layer 16 is thus 40 microns and this layer has an average oxygen permeability rate of 2 000 cm³ as measured on the ASTM D Standard 1434-63 (DIN 53380).

The covering material shown in the drawing has a combined average polymer film thickness of 65 microns (excluding the thickness of coating 14) and will have an effective shelf-life of 2 months. It will, however, be apparent that the materials used to form the covering material can vary according to customer requirements.

By way of example, a bonding agent and pesticide mixture for provision between the inner and outer layers 10 and 16 respectively of the laminated covering material was prepared by intimate mixing, in liquid form, a polyurethane resin comprising "Liofol UK 2600", a solvent comprising ethylacetate and a pesticide comprising natural pyrethrum in combination with

- piperonyl butoxide. The pesticide components were evenly distributed throughout the mixture. A hardener comprising "Liofol UK 5000" was added, in liquid form, to the above mixture
- 5 immediately prior to provision of the bonding agent between the inner and outer layers 10 and 16 of the laminated covering material. The mass of each component of the bonding agent is set out in table I below.

10

Table I

	Component	Weight (Kg)
	"Liofol UK 2600"	9,00
	Ethylacetate	10,26
	"Liofol UK 5000"	0,90
15	Natural Pyrethrum	0,888
	Piperonyl butoxide	4,44
		<hr/> 25,488 <hr/>

- The mixture was applied between the inner and outer layers 10, 16 of the laminated covering material at a volume of approximately 8 grams per m² of layer surface. The mixture was applied continuously and evenly between the layers 10 and 16 using a laminating process commonly known as sandwich printing to provide a continuous and even coating 14 between the inner and outer layers 10, 16. After lamination, the covering material was allowed to dry. A continuous and evenly distributed coating of pesticide was provided between the inner and outer layers of sheet material 10, 16. Of the 8 grams of bonding agent provided per m² of layer surface, it was found that an average of 0,312 grams of the natural pyrethrum and 3,0 grams of the piperonyl butoxide remained active.
- 35 After drying, the dry content of the components of the bonding agent was found to be that set out in table II below.

Table II

	Component	Weight (Kg)
40	"Liofol UK 2600"	5,40
	Ethylacetate	0,01
	"Liofol UK 5000"	0,675
	Pyrethrum	0,444
	Piperonyl butoxide	4,440
45		<hr/> 10,969 <hr/>

- The sheet of laminated covering material as described above was then used to form bags for the storage of edible substances and compared with untreated control bags formed from commercially available polymer film.

Granary and maize weevils were deposited, in one test, inside maize containing bags formed from covering material according to the invention

- and, in another test, on the outer surface of maize containing bags similarly formed from covering material according to the invention. The weevils exposed to the outside were trapped in contact with the bag in a petri dish. All weevils in the above tests were found to have died after 24 hours. Weevils deposited inside maize containing control bags were all alive after 7 days whereas all weevils trapped in a petri dish on the outside of the control bags were found to have died after 7 days.

- 65 Ephestia larvae were also exposed to the inside of bags formed from covering material according to the invention and all were found to have died after 6 days. In the control bags, all larvae were alive after 14 days.

- 70 20 *Ephestia* larvae were trapped in a petri dish on the outside of bags formed from covering material of the invention for a period of 14 days. Of the 20 larvae, only 4 were found to be alive after this period and these were found on the petri dish and out of contact with the bag. All larvae exposed to control bags were alive after the same period.

- It was also found that no larvae hatched from *Ephestia* eggs exposed for 7 days to bags formed from film of the invention which were used for the storage of maize meal. A number of eggs in control bags had hatched after this period.

- It will be understood that it is desirable that the pesticide incorporated in the covering material of the invention should be of a concentration and/or kind which is safe for the particular application of the material, both when the laminated layers of sheet material are intact and also when they are punctured. Preferably, the pesticide should be non-toxic to humans and other larger mammals. The pesticide used in the formation of the covering material should conform to the standards laid down by the relevant health authorities of the territories in which the bags will be used.

- Although the invention has been described and illustrated with reference to a presently preferred embodiment, it will be apparent to those skilled in the art that many variations and/or modifications are possible without departing from the scope of the appended claims. For example, although the invention has been described and illustrated with reference to laminated covering material having a shelf-life of two months, the components may be suitably varied, for example, to extend shelf-life. If, for example, the intermediate lamina 20 of outer layer 16 has an average thickness of 50 microns and not 25 microns as proposed in the example, bags formed from covering material of the invention will have a shelf-life of approximately six months.

- Matters such as the thickness and nature of the layers of sheet material, the nature and concentration of the pesticide, the manner of application of the pesticide and other features may vary to suit particular requirements. The essence of the invention resides in providing laminated covering material which may, for

example, be used for packaging or wrapping edible substances or for the production of receptacles and which is resistant to penetration by pests by the incorporation of a pesticidal

5 material between layers of the material.

The invention includes within its scope a receptacle including covering material according to the invention.

10 The receptacle may include a lining comprising covering material according to the invention.

Alternatively the receptacle may be made at least in part from covering material according to the invention.

Claims

15 1. Covering material comprising at least two laminated layers of sheet material and a continuous coating of pesticide between the layers of sheet material.

20 2. The material of claim 1 in which the layers of sheet material are united by means of a bonding agent compatible with the pesticide.

3. The material of claim 2 in which the bonding agent comprises a synthetic resin and a hardener therefor.

25 4. The material of claim 2 or 3, in which the pesticide is incorporated in the bonding agent.

5. The material of any one of the preceding claims in which the pesticide is derived from a natural source.

30 6. The material of any one of claims 1 to 5, in which the pesticide includes a pyrethrin as active ingredient.

7. The material of claim 6 in which the pesticide comprises natural pyrethrum.

35 8. The material of claim 7 in which the pesticide comprises natural pyrethrum in combination with a synergist.

9. The material of claim 7 in which the pesticide comprises a combination of natural

40 pyrethrum and piperonyl butoxide.

10. The material of any one of the preceding claims in which at least one of the layers of sheet material is permeable to the pesticide.

45 11. The material of any one of claims 1 to 10 in which both the layers of sheet material are permeable to the pesticide.

12. The material of any one of the preceding claims in which at least one of the layers of sheet material comprises a polymer material.

50 13. The material of claim 12 in which at least one of the layers of sheet material comprises ethylene vinyl acetate.

14. The material of claim 12 in which at least one of the layers of sheet material comprises a polyolefinic polymer.

55 15. The material of claim 14 in which the polyolefinic polymer comprises polyethylene.

16. The material of claim 12 in which the one layer of sheet material comprises ethylene vinyl acetate copolymer and the other layer comprises a co-extruded combination polymer film comprising inner and outer laminae of low density polyethylene and an intermediate lamina of high density polyethylene.

60 17. The material of claim 16 insofar as it is dependent on claim 11, in which the ethylene vinyl acetate layer is more permeable to the pesticide than the polyethylene layer.

65 18. Covering material substantially as herein described with reference to the accompanying drawing and example.

19. A receptacle including covering material as claimed in any one of claims 1 to 18.

70 20. A receptacle as claimed in claim 19, including a lining comprising covering material as claimed in any one of claims 1 to 18.

21. A receptacle as claimed in claim 19, made at least in part from covering material as claimed in any one of claims 1 to 18.